

LETTER TO THE EDITOR

Effect of preconditioning the pelt to different pH levels on heavy leather tannage

The phenomena of swelling and plumping have great significance in the manufacture of heavy leathers. Swelling tends to make the reactive groups of protein accessible to the tannins by widening the intermolecular spaces and by the rupture of crosslinks, particularly H-bonds due to the contraction of protein chains and widening of the gap between adjacent collagen chains in certain regions.¹ This influence of swelling tends to increase the fixation of tans. In sole leather, where compactness, high wear resistance and higher yield are important, it is customary to allow the pelt to ac-

quire the desired swelling during liming by means of suitable addition of alkali.

Marriott,² while studying the swelling of collagen, found that the acid swelling commenced from pH 3.5 downwards and alkaline swelling from pH 9.5 upwards. The swelling is minimum at pH near the isoelectric region of the pelt.

It was attempted to study here the effect of preconditioning the pelt at different pH values on the speed of penetration and the extent of fixation of vegetable tannins.

Experimental

A heavy wet salted buffalo hide was soaked and limed as in sole leather tan-

Table 1
DEGREE OF SWELLING

pH	Mean thickness (mm.)		Weight (g)		% increase/ decrease in wt.	Degree of swelling
	Initial	Final	Initial	Final		
2.5	5.2	7.3	26.4	29.5	11.74	253.0
3.0	5.2	7.2	26.4	29.6	12.02	255.0
3.5	5.2	6.9	26.8	30.0	12.00	255.0
4.0	5.1	5.7	23.3	24.8	6.50	241.5
4.5	5.1	5.0	24.1	23.9	0.80	225.1
4.8	5.2	5.1	26.2	26.0	0.75	224.0
5.3	5.2	4.9	24.8	24.0	3.20	220.0
5.8	5.4	5.3	25.3	25.1	0.80	224.0
Control 5.8	5.4	—	23.0	—	—	224.9

ning. After fleshing, scudding and washing, small pieces (6 cm. \times 6 cm.) weighing approximately 30 g., were cut off from the butt portion of the hide. The pieces were completely delimed with boric acid and then washed well in repeated changes of distilled water.

Using the buffer system of sodium acetate and hydrochloric acid (50 ml. 0.5N $\text{CH}_3\text{COONa} + \text{N HCl}$ in required quantity diluted to the desired float)³ buffer solutions of pH values varying from 2.5 to 5.8 were prepared. Delimed pelt pieces were wiped free of surface water, pressed well between folds of filter paper and then weighed; their thicknesses were measured to the approximate correction. They were then put in the above buffer solutions (400% float on pelt weight) of different pH values and allowed to remain there for 48 hours. During this period, the pH was maintained at the appropriate levels by small additions of dilute hydrochloric acid. When the system attained equilibrium, the pieces were taken out, pressed,

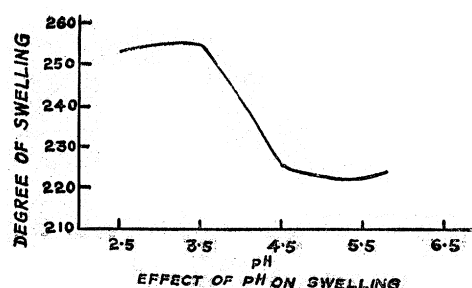


FIG. 1. Effect of pH on swelling

weighed and thicknesses measured. The degree of swelling in each case was calculated; the findings are given in Table 1.

For the calculation of the degree of swelling, one weighed piece was completely dehydrated in several changes of acetone, air dried, and dried at 99-100°C to constant weight. The loss in weight was noted and the degree of swelling⁴ calculated in terms of the content of water in grams associated with 100 g. dry pelt. The ratio between the original wet weight and the final dry weight was used for calculating the dry weight of the ex-

Table 2
RATE OF PENETRATION

pH of precondi- tioned pelt	2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	9th day
2.5	Negligible	Trace	<33%	33%	50%	75%	Full	—
3.0	"	"	33%	>33%	"	"	"	—
3.5	<33%	33%	50%	75%	75%	Full	—	—
4.0	"	"	"	"	90%	"	—	—
4.5	"	"	"	"	"	"	—	—
4.8	"	"	"	"	Full	—	—	—
5.3	"	"	"	"	"	—	—	—
5.8	"	"	"	"	90%	Full	—	—
Control	"	"	"	"	"	Full	—	—

perimental pieces put in the respective buffer solutions.

It may be observed from Table 1 that there is increase in weight and thickness in lower pH range (2.5-4.0), while at higher pH values especially in the isoelectric region there is slight depletion and loss in weight. The degree of swelling is maximum at pH 2.5-3.0 and minimum at 4.8-5.3 (Fig. 1).

Next, the pieces were taken for vegetable tanning; they were not washed since pH and physical condition of the pelt pieces may alter. They were placed in wattle liquor of 25°Bk and the strength was raised to 50°Bk after three days. This corresponded to a total tannin concentration of about 30% on pelt weight and the pieces remained in the liquor for 10 days. The extent of penetration was observed each day till completion. The observations are recorded in Table 2.

It is evident from Table 2 that the penetration is very much retarded at the

lower pH values viz., 2.5 and 3.0. The pelt adjusted to pH 2.5 prior to tanning tended to cause precipitation of the tan liquor. Near the isoelectric region of the pelt, the rate of the penetration is fairly rapid and slightly better than that of the control.

The tanned pieces were washed, very lightly oiled, allowed to dry and then weighed; the yield was determined. The general physical characteristics of the leathers were also comparatively assessed.

Table 3 shows that the pieces tanned at pH 4.5, 4.8 and 5.3 possess good colour, desirable feel and reasonably good yield. Preconditioning the pelt below 3.5 i.e., allowing the pelt to swell to its maximum, does not seem to be desirable, since apart from the very slow penetration, the final leather is exceedingly hard and also its colour very dark. At pH 2.5 tendency for precipitation was observed initially and this would explain the comparatively low uptake of tannins and the low yield. pH values

Table 3
PHYSICAL PROPERTIES OF TANNED LEATHERS

No.	pH of preconditioned pelt	Colour	Feel	Yield (%)
1.	2.5	Dark	Hard and tough	61.6
2.	3.0	" "	"	71.4
3.	3.5	Lighter than 1, but darker than 9	Less hard	71.4
4.	4.0	Lighter than 3	Less hard than 3	67.5
5.	4.5	Good colour, better than 9	Same as 9	71.0
6.	4.8	"	"	68.5
7.	5.3	"	Softer than 9	67.0
8.	5.8	Same as 9	Same as 9	57.0
9.	Control	—	—	59.0

Table 4
CHEMICAL ANALYSIS OF TANNED LEATHERS

pH of preconditioned pelt	Moisture (%)	Water solubles (%)	Hide substance (%)	Fixed tan (%)	Degree of tannage
2.5	13.62	7.36	47.37	31.65	66.8
3.0	15.25	10.14	40.06	34.55	86.2
3.5	13.50	10.01	43.05	33.45	77.7
4.0	15.00	9.80	42.66	32.54	76.3
4.5	14.50	11.00	42.28	32.22	76.2
4.8	14.00	10.50	43.30	32.20	74.3
5.3	14.20	11.20	43.00	31.60	73.5
5.8	14.10	12.00	43.50	30.40	69.9
Control	14.95	9.68	47.57	27.80	59.0

above 5.3 tend to soften the leather and the yield also suffers in comparison.

The pieces were analysed to find the degree of tannage and the results are shown in Table 4.

The results show that the fixation is maximum in the case of pH 3 and is on the decrease at higher and lower pH values (Table 4). There is a steep decline in the degree of tannage from pH 3.0 to 2.5. At the higher pH values 3.5-5.3, the decrease in degree of tannage is very gradual (Fig. 2). The tan fixation

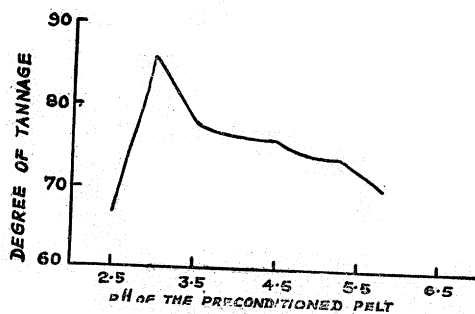


FIG. 2. Effect of pH of the preconditioned pelt on the degree of tannage

is quite good near the isoelectric region of the pelt. Since at pH 4.8-5.3 the penetration is also quick and the properties of the tanned leather are better than those of the control, it is felt advisable to precondition the pelt to its isoelectric point while aiming at rapid tanning.⁵

Conclusion

The delimed pelt pieces were allowed to swell in buffer solutions of varying pH values (2.5-5.8) and after measuring the extent of swelling as nearly as possible they were tanned in wattle liquor. It was observed that at pH values 3.0-3.5, where the swelling was maximum, there was very good fixation but the penetration was very slow and the resultant leathers were hard and dark. At pH values near the isoelectric point (about 5), the penetration was quicker; the tanned leathers had a high degree of tannage and good physical properties. Hence it is considered that pretreatment of the pelt to its isoelectric point by means of suitable

ble buffer systems is very beneficial for rapid tanning processes.

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